MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

MODELING BLUETOOTH RADIO TECHNOLOGY SIMULATON USING MULTI-AGENT BASED SYSTEM AND GENETIC ALGORITHM DESIGN PARADIGM

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This thesis uses Multi-Agent systems (MAS), and Genetic Algorithm (GA) techniques to develop a Bluetooth™ radio system simulation that is called "*Wireless World"*. Typically, wireless world is a simple two-dimensional (2D) toy model of Bluetooth™ Technology implemented in the Java programming language version 1.2.1 and Borland jbuilder3 university edition editor environment. In addition, the wireless model is designed for outdoor environment for the six different weather conditions. And in the environment, there may be situated three types of interference systems. Within these systems, the IEEE 802.11b WLAN, an alternative to the BT, is implemented as interference in the simulation environment.

The goal of the wireless world simulation is to explore the performance limitations and restrictions on the basis of the current Bluetooth™ technology specifications. The wireless world simulation will hopefully help Bluetooth™ system designers and decision-makers in gaining insight into the system performance analysis and enable them to make more informed decisions in the future.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Agents, Multi-Agent System, MAS, Agent-based Simulation, Adaptive Agents, Autonomous Agents, Relationship, Game Theory, Genetic Algorithm, Distributed Artificial Intelligence, DAI, Mobile Agent, Bluetooth, IEEE 802.11b, WLAN

OPERATIONAL-LEVEL NAVAL PLANNING USING AGENT-BASED SIMULATION

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This thesis uses agent-based modeling techniques to develop a simulation of the operational-level naval planning process. The simulation serves as an initial exploratory laboratory for analyzing the consequences of the force allocation, force deployment, and force movement decisions made by operational-level naval commanders during times of conflict or crisis. This model will hopefully help decision-makers in gaining insight into the naval planning process and enable them to make more informed decisions in the future.

The agents in the model represent the opponent operational-level naval commanders. These agents perform force allocation, force deployment, and force movement tasks based on their perceived environment, attributes, and movement personalities. There are seven naval platform types represented in the model by default, but any type of naval platform can be added to the simulation. An integrated

graphical user interface enables the user to instantiate agent and platform attributes, set simulation parameters, and analyze statistical output.

The resulting model demonstrates the ability of the agent-based modeling to capture many dynamic aspects of the operational-level naval planning process. It establishes an initial simulation tool to further explore the operational-level naval planning process.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Other (Naval Planning)

KEYWORDS: Multi-Agent System, Agent-Based Modeling, Adaptive Behavior

MODELING TACTICAL LEVEL COMBAT USING A MULTI-AGENT SYSTEM DESIGN PARADIGM (GI AGENT)

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In the past 60 years the Army has undergone a major reorganization eight times at the divisional level and numerous more times at unit levels below the division. Each time the Army reorganized it's divisions a major testing program was involved. But when a change in organization is done at unit levels below division often very little attention is paid to how the change will affect the unit. When this happens, unit leaders are forced to undertake one of the most difficult jobs in today's military incorporating new equipment into a unit or reorganizing a unit without an understanding of how the changes will affect the unit.

The Military modeling and simulation community has attempted to fill this need but the current set of single entity simulations are limited in their ability to replicate dynamic complex behavior. This thesis is attempting to create a Multi-Agent Simulation that will allow analysts and leaders to gain an understanding of the tactical employment affects of changing the organization of a company level infantry unit.

GI Agent is a simulation tool allowing the analyst and leader to experiment with the complex relationship between maneuver and unit organization without putting the unit in the field. Combining agent based artificial intelligence techniques with artificial intelligence research from the computer gaming industry, GI Agent creates a new paradigm for combat simulation.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Multi-Agent System, MAS, Combat Modeling, Human and Organizational Behavior, Agent-Based Simulation, Adaptive Agents, Autonomous Agents